B1 Continued

bottom view using the measurement values from the part definition file and the X placement value and Y placement value.

The invention further provides for using a search procedure on the image data to locate the lead.

The invention further provides for determining a lead center location and a lead diameter in pixels and storing the lead center location and lead diameter in memory.

The invention further provides for calculating an expected position of a center of each lead in both side perspective views in the image using a known position of each side view from calibration.

The invention further provides for using a subpixel edge detection method to locate a reference point on each lead.

The invention further provides for converting the pixel values into world locations by using pixel values and parameters determined during calibration wherein the world locations represent physical locations of the lead with respect to world coordinates defined during calibration.

**Amend the paragraphs from page 7, line 16 through page 8, line 11 to read as follows:**

B2

The invention further provides for converting the world values to part values using the rotation, the X placement value and the Y

B2 Cont.

placement value to define part coordinates for the ideal part where the part values represent physical dimensions of the lead including lead diameter, lead center location in X part and Y part coordinates and lead height in Z world coordinates.

The invention further provides for comparing ideal values defined in the part file to calculate deviation values that represent a deviation of the center of the lead from its ideal location. The deviation values may include lead diameter in several orientations with respect to the X placement value and Y placement value, lead center in the X direction, Y direction and radial direction, lead pitch in the X direction and Y direction and missing and deformed leads, further comprising the step of calculating the Z dimension of the lead with respect to the seating plane based on the Z world data.

The invention further provides for comparing the deviation values to predetermined tolerance values with respect to an ideal part as defined in the part definition file to provide a lead inspection result.

**Amend the paragraph at page 11, line 25 through page 13, line 12 to read as follows:**

B3

Refer now to Figure 1A which shows the apparatus of the invention configured with a calibration reticle for use during

B3 Continued

calibration of the state values of the system. The apparatus obtains what is known as a bottom image 50 of the calibration reticle 20. To take the bottom image 50 the apparatus includes a camera 10 with a lens 11 and calibration reticle 20 with a calibration pattern 22 disposed on its bottom surface. The calibration pattern 22 on the reticle 20 comprises precision dots 24. The camera 10 is located below the central part of the calibration reticle 20 to receive an image 50 described in conjunction with Figure 1B. In one embodiment the camera 10 comprises an image sensor. The image sensor may be a charged coupled device array. The camera 10 is connected to a frame grabber board 12 to receive the image 50. The frame grabber board 12 provides an image data output to a processor 13 to perform a two 15 dimensional calibration as described in conjunction with Figure 2A. The processor 13 may store an image in memory 14. The apparatus of the invention obtains an image of a pair of side perspective views and includes using a camera 15 with a lens 16 and a calibration reticle 20. The camera 15 is located to receive an image 60, comprising a pair of side perspective views, described in conjunction with Figure 1B. Fixed optical elements 30, 32 and 38 provide a first side perspective view and fixed optical elements 34, 36, 38 for a second side perspective view. The fixed optical elements 30, 32,

B3 Cont.

34, 36 and 38 may be mirrors or prisms. As will be appreciated by those skilled in the art additional optical elements may be incorporated. The camera 15 is connected to a frame grabber board 17 to receive the image 60. The frame grabber board 17 provides an image data output to a processor 13 to perform a two dimensional inspection as described in conjunction with Figure 2B. The processor 13 may store an image in memory 14. In one embodiment of the invention, the apparatus may contain a nonlinear optical element 39 to magnify the side perspective image 60 in one dimension as shown in Figure 8A. In another embodiment of the invention optical element 38 may be a nonlinear element. The nonlinear optical elements 38 and 39 may be a curved mirror or a lens.

**Amend the paragraph at page 27, line 2 through page 28, line 14 to read as follows:**

B4

Figure 7A shows one example of an image used in the grayscale blob method of the invention. The image processing method finds the location and dimensions of a ball 71 from a bottom image 80. From the expected position of a ball 71, a region of interest in image 80 is defined as (X1, Y1) by (X2, Y2). The width and height of the region of interest are large enough to allow for positioning tolerances of part 70 for

B4 (cont.)

inspection. Due to the design of the lighting for the bottom view (e.g., a ring light), the spherical shape of balls 71 of part 70 present a donut shaped image where the region 281, including the perimeter of the ball 71, comprises camera pixels of higher grayscale values and where the central region 282 comprises camera pixels of lower grayscale values. The remainder 283 of the region of interest 280 comprises camera pixels of lower grayscale values.

**Amend the paragraph at page 29, lines 6-20 to read as follows:**

B5

Figure 7B shows one example of an image used with the method of the invention to perform a subpixel measurement of the ball reference point. The method of the invention finds a reference point on a ball 71 in an image 90 of a side perspective view as shown in Figure 3B. From the expected position of a ball 71, a region of interest 290 in image 80 is defined as (X3, Y3) by (X4, Y4). The width and height of the region of interest are large enough to allow for positioning tolerances of part 70 for inspection. Due to the design of the lighting for a side perspective view (e.g., using a light diffuser), the spherical shape of balls 71 of part 70 present a crescent shaped image 291 comprising camera pixels of higher grayscale values and where the

B5 Cont'd.

remainder 293 of the region of interest 290 comprises camera pixels of lower grayscale values.